A STUDY ON COMPONENTS OF INDUSTRY 4.0 IN MANUFACTURING MSMEs OF AUTOMOBILE SECTOR OF INDIA.

Research Protocol

For Registration for Ph.D. Programme

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CERTIFICATE

It is certified that Mr. Sanjeev Kumar Sami (Reg.ID.-20PHEN012) is submitting his synopsis for Ph.D. under my guidance on the Title "A STUDY ON COMPONENTS OF INDUSTRY 4.0 IN MANUFACTURING MSMEs OF AUTOMOBILE SECTOR OF INDIA" He has prepared this synopsis under my guidance and supervision and I have gone through the content presented in this report.

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1. INTRODUCTION

The Indian automobile industry has historically been a good indicator of how well the economy is doing, presently, the automobile industry records 7.1% of India's GDP and 49% of its manufacturing GDP as the Indian automobile division plays a key role in together macroeconomic growth and technological improvement India is now the third biggest auto market in the world.

According to global forecasting agency S&P Global Mobility, Indian light vehicle sales for 2022 are put to rise by over 22% to 4.4 million units, whereas Japanese marketplace sales are probable to slip to 4.2 million units. Light vehicle sales consist of all passenger vehicles, small commercial vehicles and vans up to six tones. India has trodden Japan to become the third leading vehicle market in 2022 after US and China, selling over 4.25 million vehicles. Data from the Society of Indian Automotive Manufacturers (SIAM) shows 4.13 million vehicles together with passenger as well as commercial vehicle were sold in the nation between Januarys to November 2022. The total rises to about 4.25 million units when the sales of Maruti Suzuki for December are added.

Table-1 Showing light vehicle sell in million in different years for top four vehicle selling country

COUNTRY \ YEAR	2020	2021	2022	Vehicle Sell 'Data Taken From'
China	25.311	26.27	26.86	China Association of Automobile Manufacturers (CAAM)
United States	16.3	15.4	13.75	Light vehicle sells SAAR
India	*3	*4	4.4	global forecasting agency S&P Global Mobility
Japan	4.6	4.4	4.2	Japan Automotive dealers association

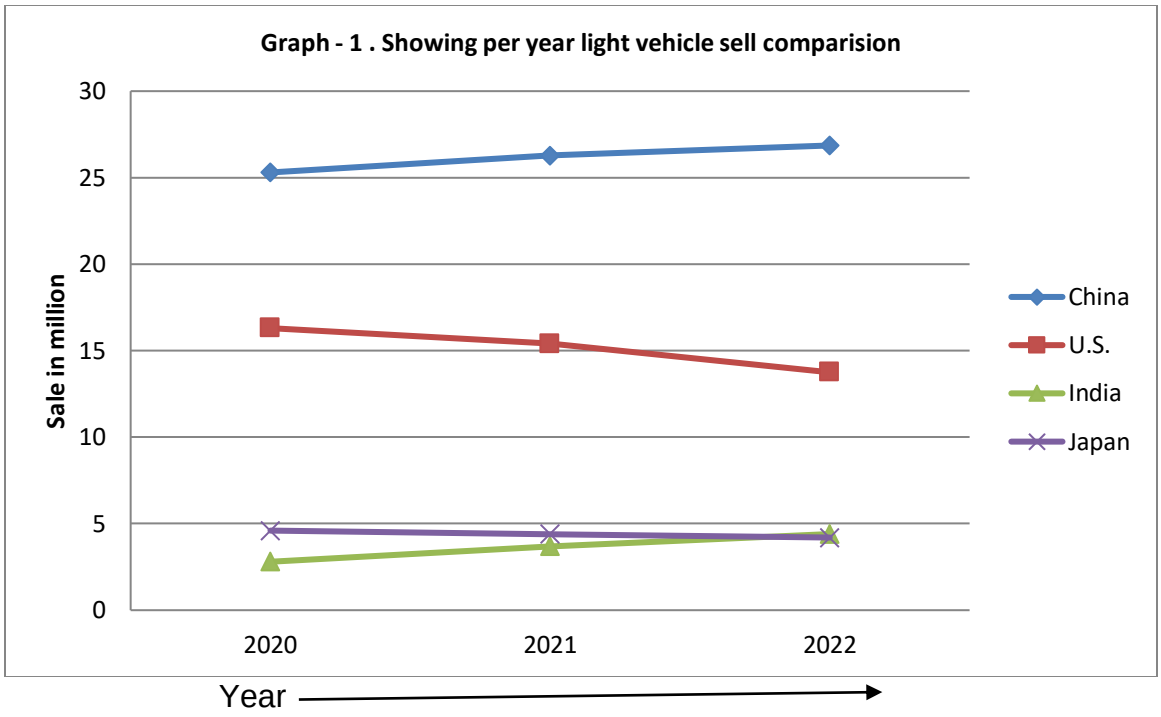


Figure -1. Graph of light vehicle sell in different years by top four countries

According to a statement from the Indian Brand Equity Foundation (IBEF), India enjoys a good place in the heavy vehicles market internationally as it is the prime tractor manufacturer, second-largest bus manufacturer, and third-largest heavy truck maker globally. India's yearly automobile manufacture in FY22 was 22.93 million vehicles .The total number figure of automobile exports improved from 41,34,047 in 2020-21 to 56,17,246 in 2021-22, viewing a optimistic growth of 35.9%, as confirmed by Smt. Anu priya Patel, the Minister of State in the Ministry of Commerce and Industry in Parliament. In latest years, number of states leading the automotive industry in India is Maharashtra, Gujarat, Tamil Nadu, Karnataka and Andhra Pradesh.

Micro, Small & Medium Enterprises (MSMEs) are an important ingredient of the Indian automotive parts manufacturing industry, which produces a ample variety of auto parts, including engine as well as transmission parts, steering mechanism components, suspension system components, exhaust systems, and other. MSMEs have also helped to make a transparent and efficient supply chain for well coordination among manufacturers and suppliers. This system has allowed for better production planning and control. MSMEs have also been involved in helping the auto components industry

reach newer. As a result, they have leveraged their price advantages to turn into more competitive in global markets, allowing them to increase their customer base and boost their revenues. The Automotive Mission Plan 2016-26 is a mutual initiative by the Government of India and the Indian automotive industry targeting to enhance the export of vehicles by five times, In FY22, total automobile exports from India stood at 5,617,246. For achieving more than from target MSMEs need to modify self with new technologies and processes to improve the quality and efficiency of production. As a result, MSMEs have been capable to expand their production quality and quantity and help big manufacturer company to produce more and more with less time so we become more competitive in the market. For that lay down the roadmap for the development of the today's industry to industry 4.0.In the time of 20th century it's a era of industrial revolution software based industry 4.0 At that time many of Indian MSMEs automotive industry need to be upgrade so that we more productivity with less input for proper Growth of the Automotive Industry in India.

The industry has been going through a revolution for the last few years, which we know popularly as Industry 4.0, or the "Fourth Industrial Revolution" *(Kang, H. S., J. Y. Lee, S. Choi, H. Kim, J. H. Park, J. Y. Son, B.H. Kim, and S. D. Noh. 2016)*. The Name "Industry 4.0" was first used in 2011 at Hannover fair It first had an official literary debut in 2013 as part of a German government initiative to encourage the modernization of the country industries (Zangiacomi et al. 2020; Xu and Duan 2019; Li 2018; Kagermann et al. 2013). We can say that industry 4.0 connects the physical world with the digital world *(Buer, Fragapane, and Strandhagen 2018)*. Although smart factories are the focus of Industry 4.0, other applications include smart transportation, logistics, buildings, goods, and grids (Osterrieder, Budde, and Friedli 2020; Schwab 2016). Here new methods and technology are being used, which affects our lives, in the coming days, the normal activities that were done by manpower are going to be technology-driven.

The fourth industrial revolution is to make the industry more comparable and cost-effective. We can work more effectively in less space and at a lower cost. We use technology to collect a lot of data and extract a lot of information easily for analysis, which helps to design our strategy and achieve result.

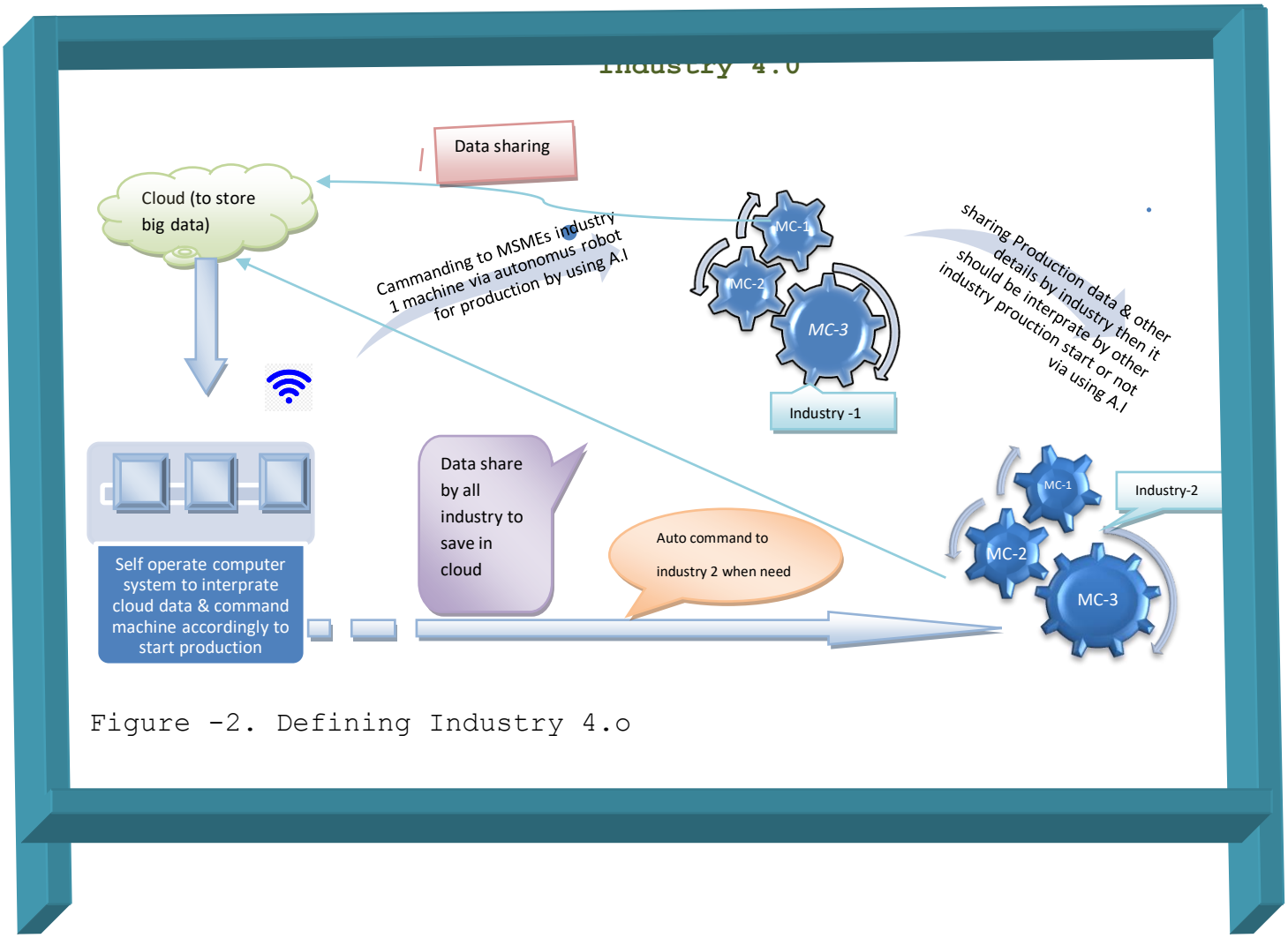

Industry 4.0
Data sharing
Cloud (to store big data)
Cammanding to MSMEs industry 1 machine via autonomus robot for production by using A.I
MC-1
MC-2
MC-3
Industry -1
sharing Production data & other details by industry then it should be interprate by other industry prouction start or not via using A.I
Data share by all industry to save in cloud
Auto command to industry 2 when need
MC-1
Industry-2
MC-2
MC-3
Self operate computer system to interprate cloud data & command machine accordingly to start production

Figure -2. Defining Industry 4.o

1.1 Advantage of Industry 4.0

- Smart industry.
- Address threats quickly.
- Stat production as per need.

- Improvement in productivity.
- Improvement in quality of the Product.
- Improved efficiency of manufacturing.
- Ready for continuous production
- Decrease in production time & cost.
- Customer satisfaction.
- Reduction in production cost & increases profit margins.
- Software & sensor also helps to worker safety & to prevent defects.

➢ **Disadvantages of Industry 4.0**

- Loss of manual job.
- Need skilled worker.
- Data security issues.
- Data sensitivity.
- Initial setup cost is very high.
- To maintain integrity of production process.
- Dependence on technology need continually update.

1.2 The Evolution of Industry 4.0

Industry 4.0 concept started in Germany in 2011. They developed this concept of how we can use integrated technology where machines talk to each other, share data, manufacture additives, etc.(*Zhou, K., Liu, T. and Zhou*, L. (2015)

Let's see how our industrial revolution has progressed.

(Kagermann, H., Helbig, J., Hellinger, A. and Wahlster, W. (2013)

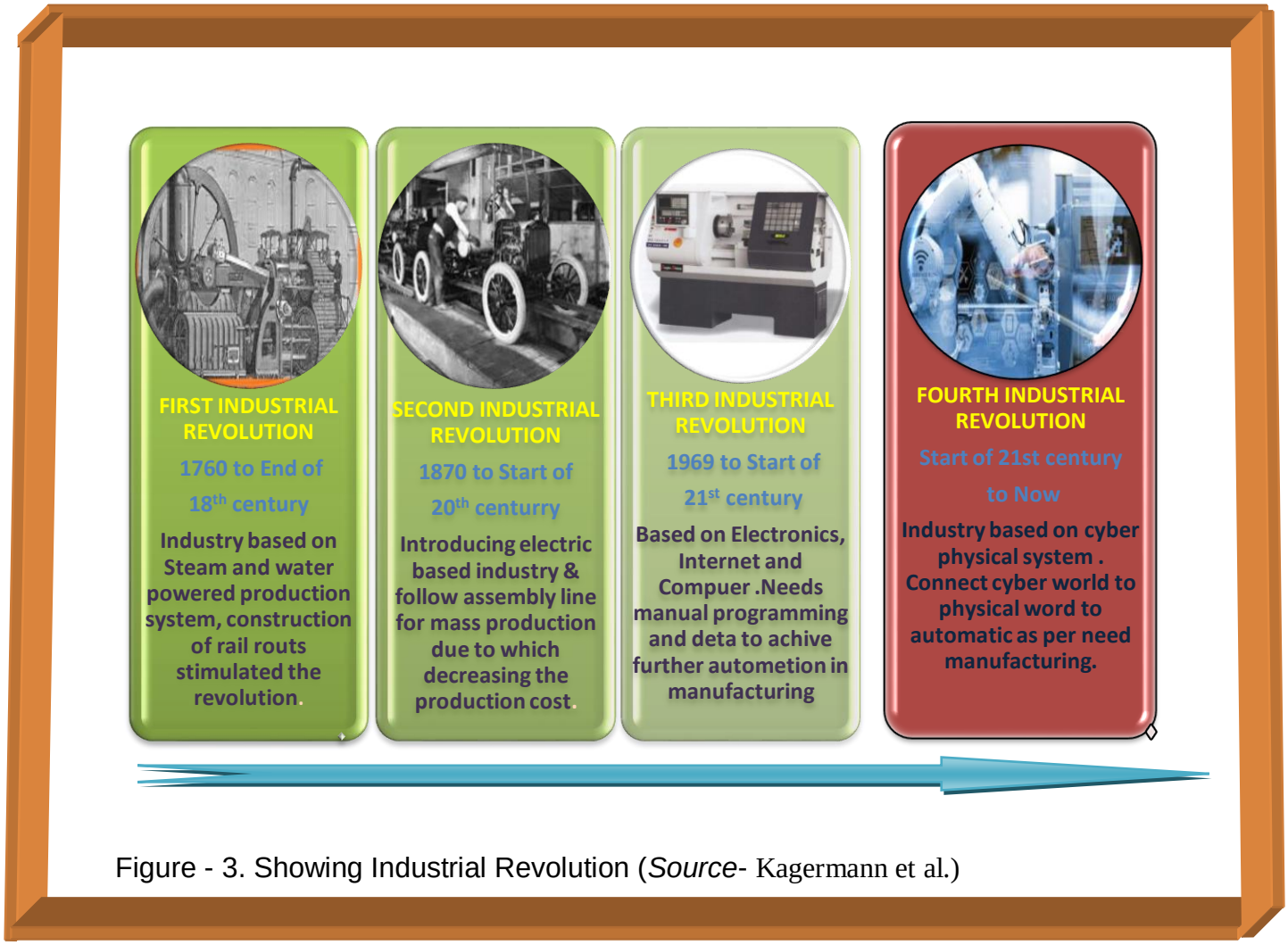

FIRST INDUSTRIAL REVOLUTION
1760 to End of 18th century
Industry based on Steam and water powered production system, construction of rail routs stimulated the revolution.
SECOND INDUSTRIAL REVOLUTION
1870 to Start of 20th centurry
Introducing electric based industry & follow assembly line for mass production due to which decreasing the production cost.
THIRD INDUSTRIAL REVOLUTION
1969 to Start of 21st century
Based on Electronics, Internet and Compuer .Needs manual programming and deta to achive further autometion in manufacturing
FOURTH INDUSTRIAL REVOLUTION
Start of 21st century to Now
Industry based on cyber physical system . Connect cyber world to physical word to automatic as per need manufacturing.

Figure - 3. Showing Industrial Revolution (*Source*- Kagermann et al.)

- **The First Industrial Revolution**

Industry based on steam and water-powered production systems.

- During 1760-1840
- Driver: The invention of the steam engine and the construction of rail routes stimulated the revolution.
- Results: Utilization of machines in production.

- **The Second Industrial Revolution**

Industry based upon electricity.

- During the transition from the 19th century to the 20th
- Driver: Electricity and assembly lines triggered the revolution.
- Results: mass production.

- **The Third Industrial Revolution**.

Based on electronics and computers,

- Initiated in the 1960s
- The production of semiconductors sparked the revolution.
- Results: mainframe, personal computer, internet.

- **The Fourth Industrial Revolution**

Industries based on cyber-physical systems

- Stimulated in the 21st century
- Proposed to uplift the German economy.
- The Digital Revolution triggered the revolution.
- Extensive use of the ubiquitous and mobile internet
- During the revolution, sensors became cheaper, smaller in size, and more powerful.
- Extensive use of Artificial Intelligence, Machine Learning, Cyber Physical Systems (CPS)

In the 21st century, industry 4.0 connects the Internet of Things (IOT) with manufacturing techniques to enable systems to share information, analyze it, and use it to guide intelligent action.

1.3 Major Components of Industry 4.0

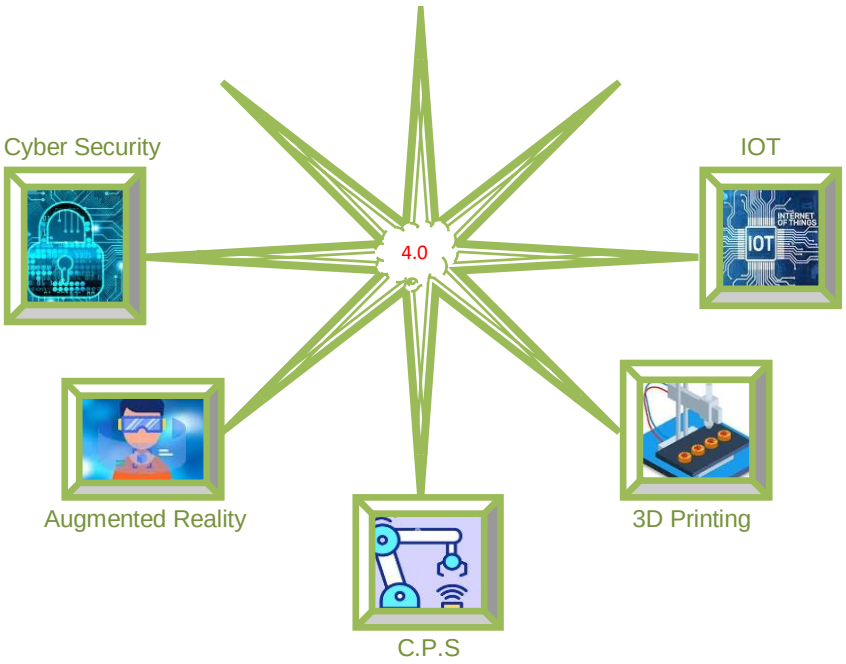


Figure-4. Major Components/Technology of Industry 4.0.

- Major Components/ Technology of Industry 4.0 are:-
  (Aktas and Meng, 2017; Caro and Sadr, 2019; Lu Y, 2017; Zhong and Xu, 2017)

  - Additive Manufacturing.
  - Augmented Reality
  - Autonomous Robots
  - Big Data Analytics
  - The Cloud
  - Cyber Security
  - The Industrial Internet of Things.(I.O.T)
  - Cyber Physical System (C.P.S)

- **Additive Manufacturing**: In conventional manufacturing, we remove the material and make the desired shape. Like drilling and milling, these operations are material removal operations. Here wastage of material takes place. Whereas additive manufacturing is the opposite of conventional manufacturing, it's a computer controlled process that creates three-dimensional objects by depositing

materials, usually in layers. It is also called 3D printing (Yin, Y., Stecke, K.E. and Li, D. (2018).

- **Augmented Reality**: The things that remain are not real but give a feeling of reality. It is a technology that creates an enhanced version of the real world in front of us by adding a layer of digital information on top of that.

- **Autonomous Robots**: Robots are programmable machines that are usually able to carry out a series of actions autonomously or semi-autonomously. Autonomous robots that do not require much command can do many activities by themselves *(Galin and Meshcheryakov, 2019).*

- **Big Data Analytics**: It's a process of storing and examining large volumes of data from various sources and systematically extracting useful information from it (Weber, 2009). Data helps in many ways, such as: by collecting a lot of data, companies know the requirements of the consumer, their problems, and their desires.

- **The cloud**: A complete network designed to save data on the Internet. use of remote servers to store, manage, and process data which can be accessed through the internet on demand. Through this, things become more economical because we use as much as we need, which reduces the operational cost significantly (*Foster, I., Zhao, Y., Raicu, I. and Lu, S. 2008)*

- **Cyber Security**: Cyber security is the practice of defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks.

- **The Industrial Internet of Things**: It means things are interconnected. It's a network of physical objects that are able to collect data with the help of sensors and exchange data with each other with the help of the internet. With the help of IOT, machines are connected to each other, communicating with each other, getting information from one machine to another

- *(Vermesan, O., Friess, P., Guillemin, P., Gusmeroli, S., Sundmaeker, H., Bassi, A.,Jubert, I.S., Mazura, M., Harrison, M., Eisenhauer, M. and Doody, P. 2011).*

2. Motivation for the Work

Due to the increasing global competition need to enhance manufacturing, it has become necessary to optimize the production process to increase productivity. Most of the MSMEs automobile industry in India is conventional so we get low productivity and poor finished product. Conventional manufacturing process also take times more time in production so long lead time & increase in direct and indirect cost of production overall involved for increase in product rate . Conventional industries are also very harmful for worker sometime If the worker's attention is diverted from the machine while doing his work & caution is not taken, their hands or legs may be cut it has even been seen that so many lives have been lost also seen that harmful gases are released from many raw material effect their health .

To fix all these problems, the worker will not have to stay near the machine, reduce the lead time, improve the surface finish of the product, reduce the direct and indirect cost, which will increase the efficiency of the industry. Productivity will increase and the quality of the product will increase and the rate will decrease. There is only and only one solution for all these, adopting Industry 4.0.This work helps MSMEs industry to decrease the barriers to implement industry 4.0 in Indian automotive industries

3. LITERATURE REVIEW

This review consists of a four-step research approach.

- **The first step Shows us the time** period i.e., from 2011 to mid-2022, where the year 2011 is considered as the outset for the collection as the word ind-4.0 evolved in this year itself. After being introduced in 2011 at a trade fair in

Germany, the term Industry 4.0 has gained international attention(Liao, Deschamps, Loures, & Ramos, 2017; Roblek, Meško, & Krapež, 2016; Wang, Wan, Zhang, Li, &Zhang, 2016).

- **The second step** collects research publications, i.e., the publications which were selected from publishers of management science such as Emerald Online, Taylor & Francis, Wiley Inter science (earlier BlackwellSynergy) and Science Direct.
- **The third step** gives the idea about the selection of research publications from the database using various search keywords such as Industry 4.0,Perfomance,
- **The Fourth step** gives us the idea about the removal of duplications of articles and after the removal of duplications, the next step is the identifications of filtered articles. And lastly, the identified articles are categorized in various points such as, the classifications of journal-wise articles, the research which is published per year, studies done across the countries, growth in empirical research in Ind-4.0, performance measurement, tools used.
- After rigorous studies and brainstorming, few important documents are stuck-out from the well referred journals and these are presented in Table 1. The table contains: Name of the author, the country of research, year of research publication, research design, and also discuss their contribution to research.

- **Verma & Venkatesan (2021) :-** This review Based on an examination of worldwide literature on Industry 4.0 and the automotive. Discuss about successful implementation of industry 4.0 in Indian automotive industry mainly focus on recruit , retain, and trained their staff as per need, as well as create a learning environment so that values innovation and lifelong learning via re-skilling and up-skilling .This review paper mainly trying to fill the gap and

create a workforce framework, in order to increase organizational performance in the Indian automotive industry

- **Hickie & Hickie (2021) :-** This Research paper done through analysis Automotive Original Equipment Manufacturers & literature review. The research illustrates how globalised, industrial sectors like aerospace and automotive are adopting Industry 4.0 technology It is suggested that the adoption and integration of Industry 4.0 technologies might impact on geographical distribution, perhaps attracting new regions and changing the prominence of long-established ones also say in the upcoming decade, the widespread use of digital technology will probably only strength.
- **Mohanta & Mahanty:-** This article identified 14 important success criteria from existing literature for implementing Industry 4.0 technology and find out how to deploy Industry 4.0 in Indian manufacturing MSMEs by identifying the critical success factors (CSFs) and deriving the hidden structures.. Furthermore, an empirical study of 222 MSMEs in India's automobile manufacturing industry was conducted. Focused to utilize exploratory factor analysis and structural equation modeling to find hidden components and analyze the influencing relationships between them.
- **Moeuf et al. (2017):-** This review shows that SMEs frequently restrict themselves to the use of Cloud Computing and the Internet of Things and do not fully utilize all the resources available for implementing Industry 4.0. In conclusion, analysis of the literature reveals that reported Industry 4.0 projects in SMEs continued to be cost-driven.

- **Giuliani & Gurau (2020):-** Thorough literature analysis and hands-on observations of a functioning performance management system focused on non-technological management advancements that are essential for the successful installation and operation of an Industry 4.0 performance management system. This research highlighted two key management tenets of performance

management system 4.0—solidarity among actors and adherence of all players—and various particular characteristics of these systems.

- **Ghiron & Tiburzi :-**This paper provides a holistic framework that analyses the relationships among Industry's 4.0 enabling technologies, barriers and Goals. Introducing 9 types of Industry 4.0 enabling technologies and depending on how they are combined, they may help accomplish up to 15 distinct business objectives or they can create 21 obstacles that prevent them.
- **Jamwal et al. :-** Preset a case study of an Indian MSMEs trying to implement Industry 4.0 practices has been conducted. A framework is developed using a hybrid MCDM (multi-criteria decision making) method based on the F-AHP (fuzzy-analytical hierarchy process) and DEMATEL (decision making trial and evaluation laboratory) and findings showed that Industry 4.0 sustainability constraints are mostly caused by supply chain and environmental enablers.
- **Sebastian Thiede**:- This Literature review based on the Information and communication technologies (ICT) . Giving digital solutions to facilitate more environmentally sustainable manufacturing. The study examines the topic if and how digital technology, methodologies and tools may promote the environmental related improvement in manufacturing and introduces a reference framework based on the requisite industrial system comprehension and the identification of pertinent fields of activity.
- **Gouda & Tiwari (2023):-** Focus on India's automobile industry which has been badly hit by Covid-19, want to identify the main enablers for the implementation of industry 4.0. This research offers a comprehensive TISM hierarchical framework on I4.0 adoption that will advance to the next stage of innovation adoption maturity and might serve as a guide for the automotive sectors during the COVID-19 pandemic. According to the findings, the most important variables are senior management support, government policy clarity, a strategic vision for I4.0, and the creation of new industrial policies. Additionally, linking enablers with the highest.
- **Krishnan et al. (2021):-** This study is to evaluate the major sector 4.0 enablers in relation to the Indian auto sector. It is done in order to understand their relative

impact on implementing I4.0 concepts and technologies in manufacturing industries, in the context of developing countries. Manufacturers will have the chance to take use of this industry generation's advantages as we move towards I4.0. The crucial enablers are verified by utilizing the interpretive structural modeling (ISM). also MICMAC analysis used to group the I4.0 enablers.

- **Virmani et al. (2021):-** Finding the various obstacles that MSMEs face when attempting to apply sustainable manufacturing practices. Additionally, pay attention to measuring the relative strength of these obstacles in order to comprehend the significance and strength of the observed variables significance and strength of the observed variables dependencies .There are 22 obstacles in the way of "sustainable manufacturing". The EFA and CFA models supported the existence of four distinct sorts of barriers. Production and operations-related, organizational-related, collaboration-related, and laws and regulations of the government are the order of importance in which they are listed.
- **Zheng Li et al. (2022):-** The purpose of this paper is to investigate the methods and techniques Chinese automakers use to compete globally. It compares their strengths and potentials to those of global counterparts' development experiences and offers policy recommendations for fostering world-class automakers. The evaluation's findings imply that Chinese automakers still lag behind their top-tier competitors. With the help of its considerable technological capacity and enormous market size, Chinese companies may become world-class, at least in some niche markets.
- **Pulova et al. (2022):-** Examine particular Industry 4.0 technologies, such as sophisticated robots, 3-D animation, IOT, and automated production that are being implemented by industrial firms. The paper's primary area of interest is automated production, with an emphasis on Industry 4.0-related technologies in the automobile sector. The findings revealed widespread usage of industrial robots, programmable devices like PLCs, and sensors.
- **Fauzdar et al. (2022):-** The purpose of this study is to list and categories major Industry 4.0 elements that might have an effect on the Indian automotive industry. Analyzing several sectors of industry4.0 elements that would affect the

Indian automotive sector, the study's goal is realized. The study's limitations might be due to expert opinions being biased. The results may aid organizations in comprehending the effects of Industry 4.0 and in further assisting them in tailoring their market-appropriate strategies.

Table-2. Literature Review

S. NO.	**Author & Publication year**	**Research Design**	**Methodology used**	**Concentration of Research**	**Contribution of Research**	**Research Output**
1	Verma & Venkatesan (2021)	**review** paper	Based on an examination of worldwide literature on Industry 4.0 and the automotive industry	This study aims to fill the gap and create a workforce framework, in order to increase organizational performance in the Industry 4.0 paradigm	The Fourth Industrial Revolution and its effects on the workforce in the Indian automobile sector are directly related, according to the research. It also looks at how the Industry 4.0 paradigm is affecting the job of HR experts.	This study sheds light on how firms can successfully adopt Industry 4.0 in the Indian automotive sector. Depends on employers' capacity to successfully recruit, retain, and trained their staff, as well as to promote an environment that values innovation and lifelong learning via re-skilling and up-skilling.
2	Hickie & Hickie (2021)	Research paper	According to an analysis OEMs (Automotive Original Equipment Manufacturers) .& literature review	Talk about in the upcoming decade, the widespread use of digital technology will probably only strengthen these trends.	The research illustrates how globalised, industrial sectors like aerospace and automotive are adopting Industry 4.0 technology.	It is suggested that the adoption and integration of Industry 4.0 technologies might impact on geographical distribution, perhaps attracting new regions and changing the prominence of long-established ones.
3	Mohanta and Mahanty (2021)	Research paper	SEM (structural equation Modeling) was used to test hypotheses & using EFA with the help of a questionnaire survey among Indian automotive manufacturing MSMEs	Focused to utilize exploratory factor analysis and structural equation modeling to find hidden components and analyze the influencing relationships between them.	This article identified 14 important success criteria from existing literature for implementing Industry 4.0 technology. Furthermore, an empirical study of 222 MSMEs in India's automobile manufacturing industry was conducted.	Find out how to deploy Industry 4.0 in Indian manufacturing MSMEs by identifying the critical success factors (CSFs) and deriving the hidden structures.
4	Moeuf et al. (2017)	Literature review	Papers are categorized by new framework that helps to identify the chosen case intended performance objectives necessary managerial skills, and chosen set of technology.	This provides a review of prior applied research that addresses several SMEs-related concerned to Industry 4.0.	The adoption of Industry 4.0 principles by SMEs appears to be limited to the monitoring of industrial processes.	Results indicate that SMEs frequently restrict themselves to the use of Cloud Computing and the Internet of Things and do not fully utilize all the resources available for implementing Industry 4.0. In conclusion, analysis of the literature reveals that reported Industry 4.0 projects in SMEs continued to be cost-

						driven.
5	Robert et al. (2022)	Research paper	Thorough literature analysis and hands-on observations of a functioning performance management system.	Primarily focused on non-technological management advancements that are essential for the successful installation and operation of an Industry 4.0 performance management system.	The goal is to identify the qualities that an Industry 4.0 performance management system has to have in order to clearly integrate the human aspect, as well as the fundamental concepts upon which such a system ought to be built.	This research highlighted two key management tenets of performance management system 4.0—solidarity among actors and adherence of all players—and various particular characteristics of these systems.
6	Calabrese et al. (2020)	Review paper	A sampling of the publications gathered via a thorough literature review	Focus on 9 types of Industry 4.0 enabling technologies and depending on how they are combined, they may help accomplish up to 15 distinct business objectives or they can create 21 obstacles that prevent them.	This paper provides a holistic framework that analyses the relationships among Industry's 4.0 enabling technologies, barriers and Goals.	As part of the Industry 4.0 transition, this study creates a framework to help managers achieve the objectives that have not yet been fully realized.
7	Jamwal et al. (2021)	Research paper	The framework is developed using a hybrid MCDM (multi-criteria decision making) method based on the F-AHP (fuzzy-analytical hierarchy process) and DEMATEL (decision making trial and evaluation laboratory).	A case study of an Indian MSMEs trying to implement Industry 4.0 practices has been conducted.	The goal of the current study was to provide a framework for sustainable business practices for the MSMEs (Micro Small Medium Enterprises) sector of Industry 4.0. Initial research on Industry 4.0's facilitators of sustainability was done using the literature that was accessible.	The findings showed that Industry 4.0 sustainability constraints are mostly caused by supply chain and environmental enablers.
8	Sebastian Thiede (2021)	Literature review	Information and communication technologies (ICT)	Giving digital solutions to facilitate more environmentally sustainable manufacturing	The study examines the topic if and how digital technology, methodologies and tools may promote the environmental related improvement in manufacturing	This research introduces a reference framework based on the requisite industrial system comprehension and the identification of pertinent fields of activity.
9	*SaadAmjad et al (2021)*	Literature review,	Multi methodological approach was used	Established 9 dimensions and	In this study, provide a novel, empirically supported methodology	Creation of an assessment tool and a maturity model for

			to construct the model, including systematic literature reviews, conceptual modeling, and qualitative and quantitative techniques for empirical validation.	62 items to each of them to evaluate the maturity of Industry 4.0.	and its application to evaluate the Industry 4.0 readiness of industrial businesses in the field of discrete manufacturing.	the industry Enterprise manufacturing maturity at industry 4.0
10	Gouda & Tiwari (2023)	Research paper	Utilizing the total interpretive structural modeling (TISM) method, the hierarchical digraph was created. Lastly, classification using fuzzy cross-impact matrix multiplication (MICMAC)	Focus on India's automobile industry which has been badly hit by Covid-19 , want to identify the main enablers for the implementation of industry 4.0	This research offers a comprehensive TISM hierarchical framework on I4.0 adoption that will advance to the next stage of innovation adoption maturity and might serve as a guide for the automotive sectors during the COVID-19 pandemic.	According to the findings, the most important variables are senior management support, government policy clarity, a strategic vision for I4.0, and the creation of new industrial policies. Additionally, linking enablers with the highest driving and dependency power are recognized as having an agile workforce, smart HR practices.
11	Krishnan et al. (2021)	Research paper	The crucial enablers are verified by utilizing the interpretive structural modeling (ISM). also MICMAC analysis used to group the I4.0 enablers .	This study is to evaluate the major sector 4.0 enablers in relation to the Indian auto sector.	It is done in order to understand their relative impact on implementing I4.0 concepts and technologies in manufacturing industries, in the context of developing countries. Manufacturers will have the chance to take use of this industry generation's advantages as we move towards I4.0.	Propose a framework which helps automobile industry can use a framework to improve their competitiveness in the market, which would ultimately benefit the growth of the Indian economy driven by these companies.
12	Virmani et al. (2021)	Research paper	Both exploratory and confirmatory factor analyses (EFA and CFA) were carried out. Finally, utilizing the GTMA (Graph Theory and Matrix Approach), barriers are ranked.	Give insightful information on the 22 barriers to sustainable manufacturing and how they affect MSMEs in the automotive industry.	Finding the various obstacles that MSMEs face when attempting to apply sustainable manufacturing practices. Additionally, pay attention to measuring the relative strength of these obstacles in order to comprehend the significance and strength of the observed variables' dependencies.	Findings 22 obstacles in the way of "sustainable manufacturing". The EFA and CFA models supported the existence of four distinct sorts of barriers., and laws and regulations of the government are the order of importance in which they are listed.

13	Zheng_Li et al. (2022)	Research paper	analytic hierarchy process	Chinese automakers' competitiveness, as well as offers informed commentary on the country's industrial policy in the sector.	The purpose of this paper is to investigate the methods and techniques Chinese automakers use to compete globally. It compares their strengths and potentials to those of global counterparts' development experiences and offers policy recommendations for fostering world-class automakers.	The evaluation's findings imply that Chinese automakers still lag behind their top-tier competitors. With the help of its considerable technological capacity and enormous market size, Chinese companies may become world-class, at least in some niche markets.
14	Pulova et al. (2022)	Research paper	Questioner survey	Examine particular Industry 4.0 technologies, such as sophisticated robots, 3-D animation, IOT, and automated production that are being implemented by industrial firms.	The paper's primary area of interest is automated production, with an emphasis on Industry 4.0-related technologies in the automobile sector.	Examined the extent to which Industry 4.0 technologies, including those related to automation, are being used. The findings revealed widespread usage of industrial robots, programmable devices like PLCs, and sensors.
15	Fauzdar et al. (2022)	Research paper	literature survey, Structural Equation Modeling (SEM) MICMAC (Matriced 'impactscroisés multiplication appliquée á un classment),	The purpose of this study is to list and categories major Industry 4.0 elements that might have an effect on the Indian automotive industry.	Analyzing several sectors of industry4.0 elements that would affect the Indian automotive sector, the study's goal is realized.	The study's limitations might be due to expert opinions being biased. The results may aid organizations in comprehending the effects of Industry 4.0 and in further assisting them in tailoring their market-appropriate strategies.

4. Literature gap

Different researchers have carried out experiments for much industry but no one focus on Indian MSMEs Automobile Industry to give conceptual model based on enablers and barriers through MCDM method. This frame work helps the industrialist to take decision to implement industry 4.0.

- It is found from the literature review that no researcher has yet attempted to take into account To Identify and rank the Enablers /CSFs to implement industry 4.0 components in automotive sector of India using MCDM technique and justify MCDM technique by support of literature.

- There is a complete dearth of literature to find critical failure factor using multi criteria decision making technique to implement industry 4.0 in Indian MSMEs industry.

- To develop conceptual model based on enablers and barriers of industry 4.0 within automotive sector of India is another gap to be filled since no such work has been reported

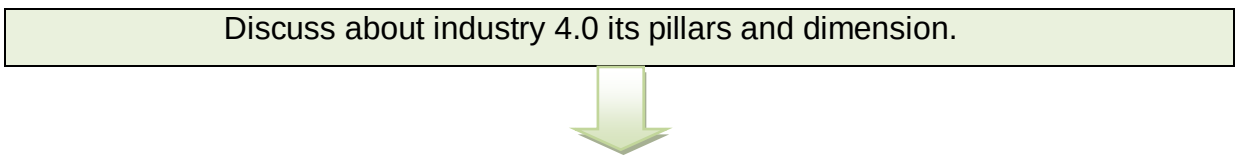
5. OBJECTIVES OF THE STUDY

- To Identify and rank the Enablers /CSFs to implement industry 4.0 components in automotive sector of India using MCDM technique and justify MCDM technique by support of literature.
- To identify / analyze and ranking of barriers / CFFs to implement industry 4.0 components using MCDM technique.
- To develop conceptual model based on enablers and barriers of industry 4.0 within automotive sector of India.

6. RESEARCH METHODOLOGY TO BE ADOPTED

To achieve the above objective, steps will be designed as below

Work flow:



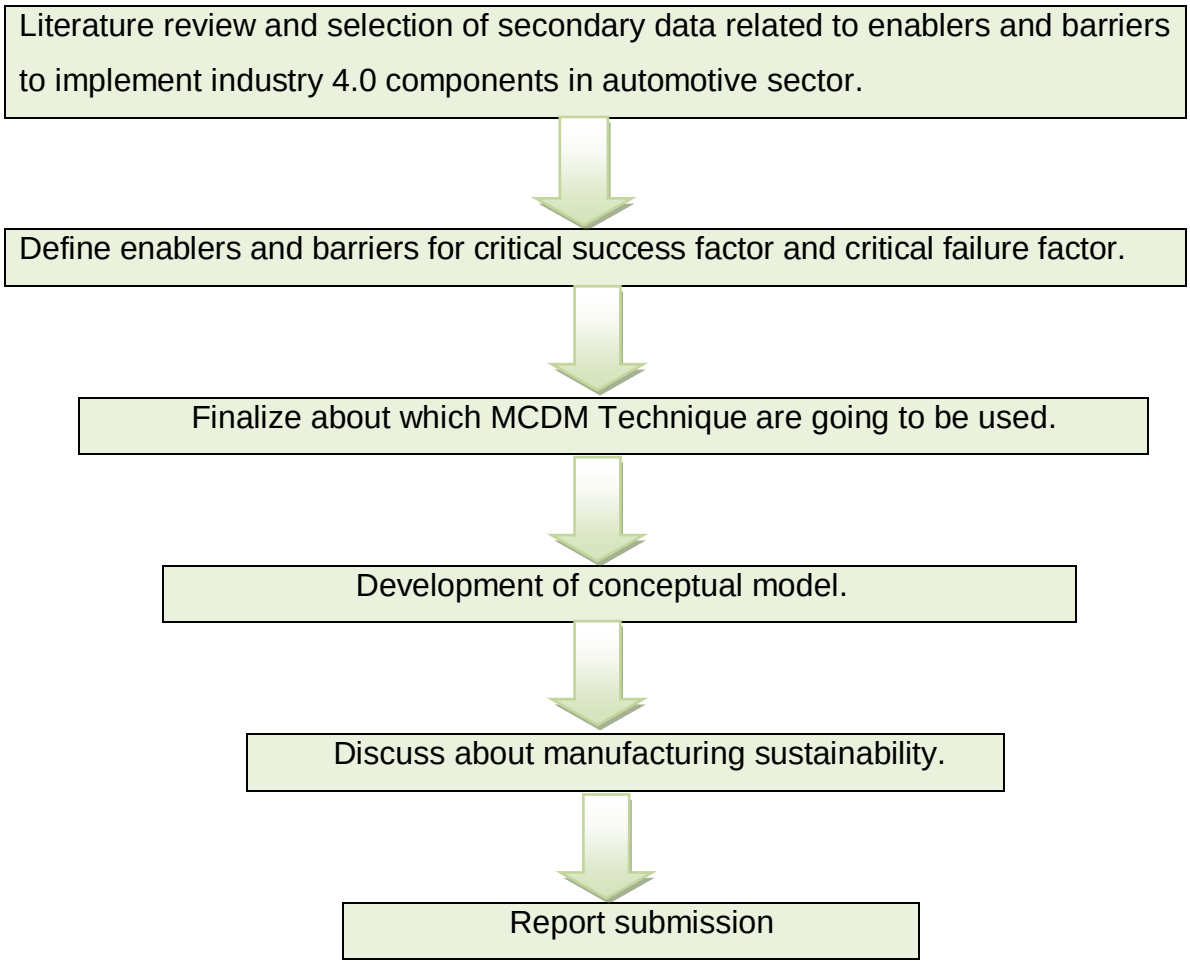

Literature review and selection of secondary data related to enablers and barriers to implement industry 4.0 components in automotive sector.
Define enablers and barriers for critical success factor and critical failure factor.
Finalize about which MCDM Technique are going to be used.
Development of conceptual model.
Discuss about manufacturing sustainability.
Report submission

Figure-5. Work flow method to achieve objective.

Table -3. Time schedule of activities to given milestones:

	3 Month	6 Month	9 Month	12 Month	15 Month	18 Month	21 Month	24 month
Phase 1	←					→		

Phase 2				⟷				
Phase 3					⟷			
Phase 4						⟷		
Phase 5							⟷	
Phase 6								⟷

7. **REFRENCES**

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